ABSTRACT

In a communication system, channel operating parameter carrier frequencies are located in the vicinity of data nulls in a data spectrum. The operating parameter carriers are summed with the data signal. At the receiver, the operating parameter carrier frequencies are recovered by demodulation techniques, and the operating parameters are recovered and processed.

File: OCOPFNT2W Data output

Time Stamp
Year= 2001, Month= 3, Day= 15, Time (EST) = 20:1:59.2 ;
Computation Time (sec)=0 ;
***** Repeaters have been found with an accuracy of 1 Bit(s) or 0.2 Km *****
Word length (Bits)= 32.0; Run Number = 1.0; Peak Value (Sum of Bits) = 17.04

Distance; Km;	Relative to 1st; Km;	Inter-Repeater Span Km;	Bits;	log2(Bits)
6.00;	0.00;	0.00;	30.0;	4.91
6.20;	0.20;	0.20;	31.0;	4.95
6.40;	0.40;	0.20;	32.0;	5.00
25.20;	19.20;	18.80;	126.0;	6.98
25.40;	19.40;	0.20;	127.0;	6.99
25.60;	19.60;	0.20;	128.0;	7.00
44.40;	38.40;	18.80;	222.0;	7.79
44.60;	38.60;	0.20;	223.0;	7.80
44.80;	38.80;	0.20;	224.0;	7.81
63.60;	57.60;	18.80;	318.0;	8.31
63.80;	57.80;	0.20;	319.0;	8.32
64.00;	58.00;	0.20;	320.0;	8.32

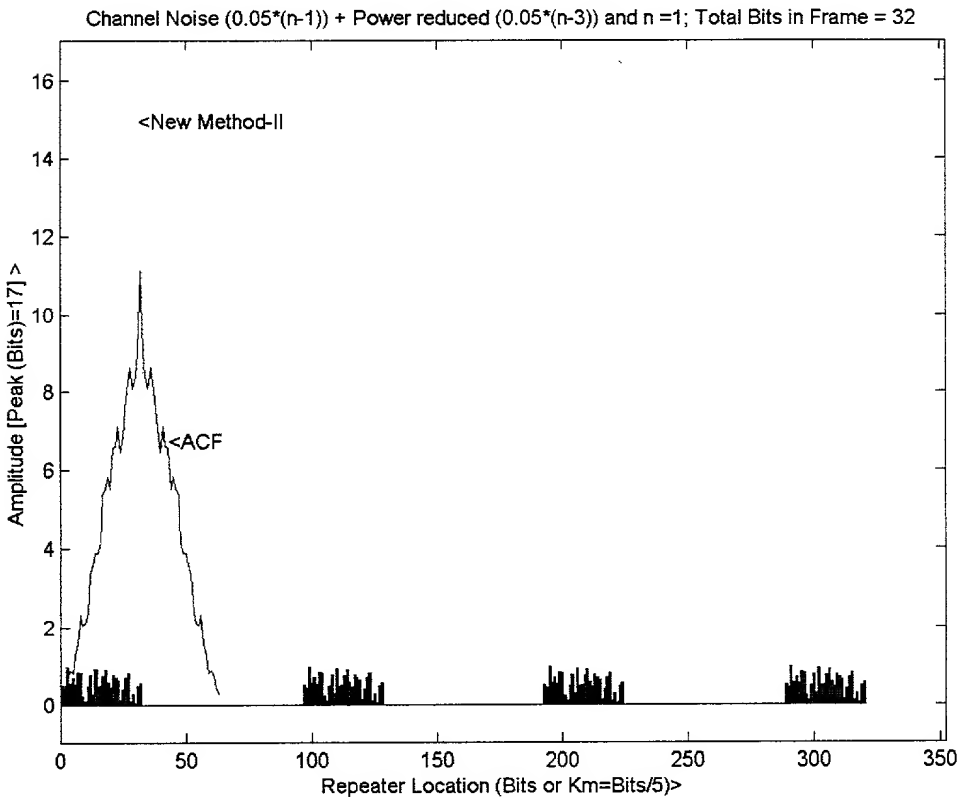
Time Stamp
Year= 2001, Month= 3, Day= 15, Time (EST) = 20:2:4.97 ;
Computation Time (sec)=0 ;
***** Repeaters have been found with an accuracy of 1 Bit(s) or 0.2 Km *****
Word length (Bits)= 32.0; Run Number = 2.0; Peak Value (Sum of Bits) = 43.09

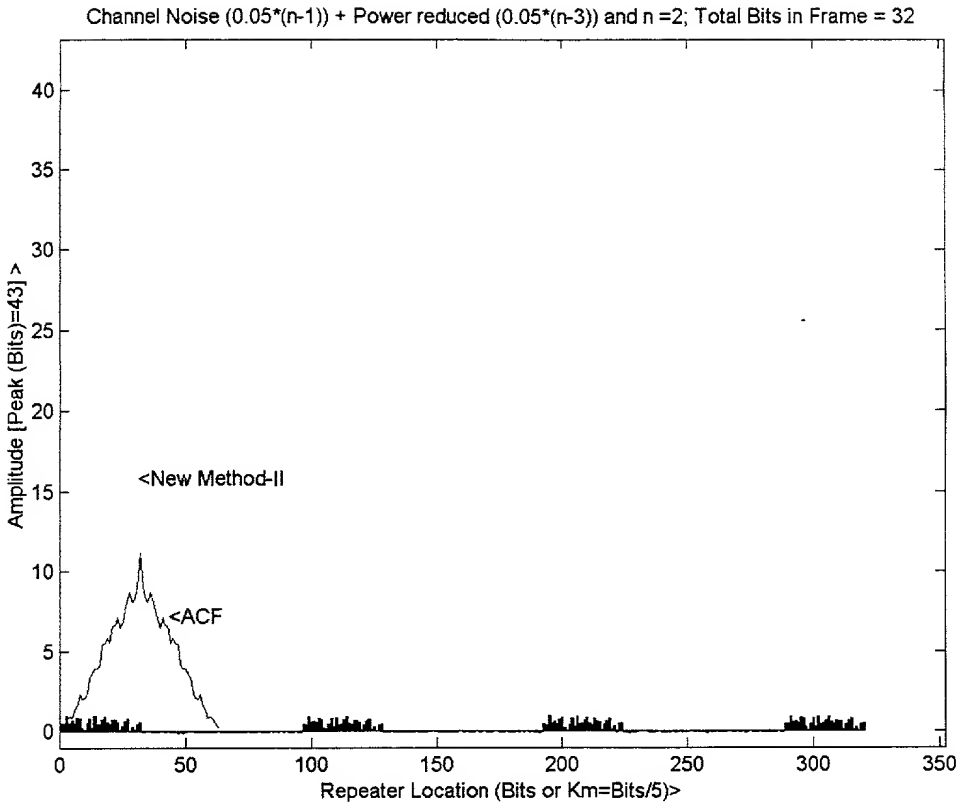
Distance; Km;	Relative to 1st; Km;	Inter-Repeater Span Km;	Bits;	log2(Bits)
23.40;	0.00;	0.00;	117.0;	6.87
23.60;	0.20;	0.20;	118.0;	6.88
23.80;	0.40;	0.20;	119.0;	6.89
24.00;	0.60;	0.20;	120.0;	6.91
24.20;	0.80;	0.20;	121.0;	6.92
24.40;	1.00;	0.20;	122.0;	6.93
24.60;	1.20;	0.20;	123.0;	6.94
24.80;	1.40;	0.20;	124.0;	6.95
25.60;	2.20;	0.80;	128.0;	7.00
64.00;	40.60;	38.40;	320.0;	8.32

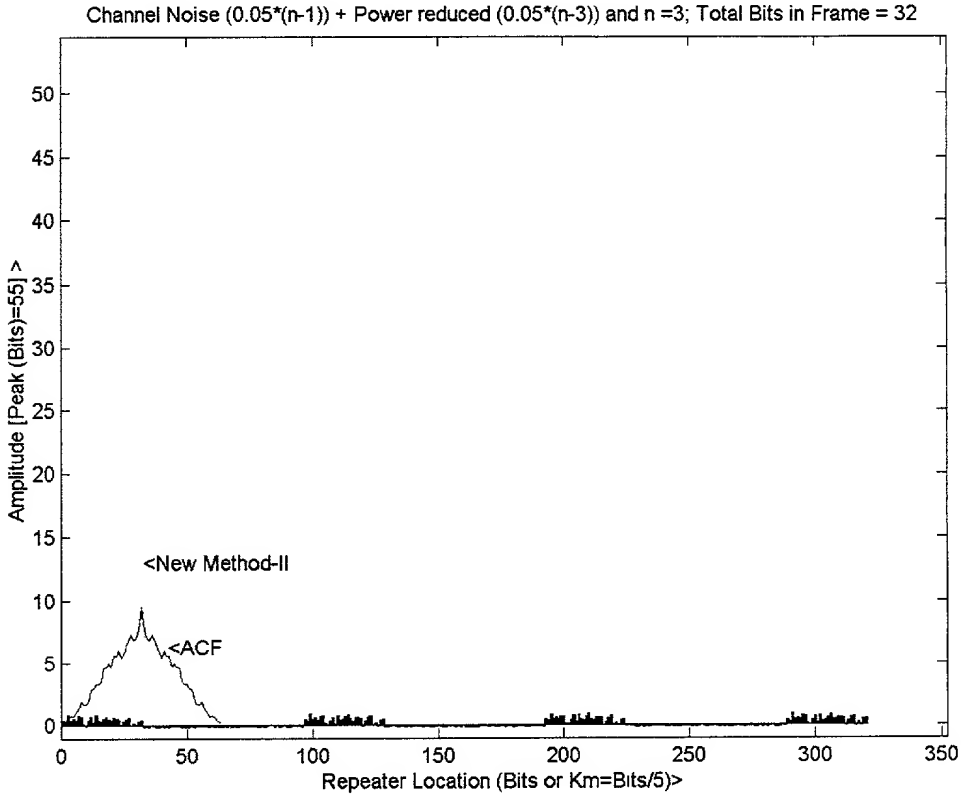
Time Stamp
Year= 2001, Month= 3, Day= 15, Time (EST) = 20:2:8.32 ;
Computation Time (sec)=0 ;
***** Repeaters have been found with an accuracy of 1 Bit(s) or 0.2 Km *****
Word length (Bits)= 32.0; Run Number = 3.0; Peak Value (Sum of Bits) = 54.51

Distance; Km;	Relative to 1st; Km;	Inter-Repeater Span Km;	Bits;	log2(Bits)
43.80;	0.00;	0.00;	219.0;	7.77
44.00;	0.20;	0.20;	220.0;	7.78
44.60;	0.80;	0.60;	223.0;	7.80

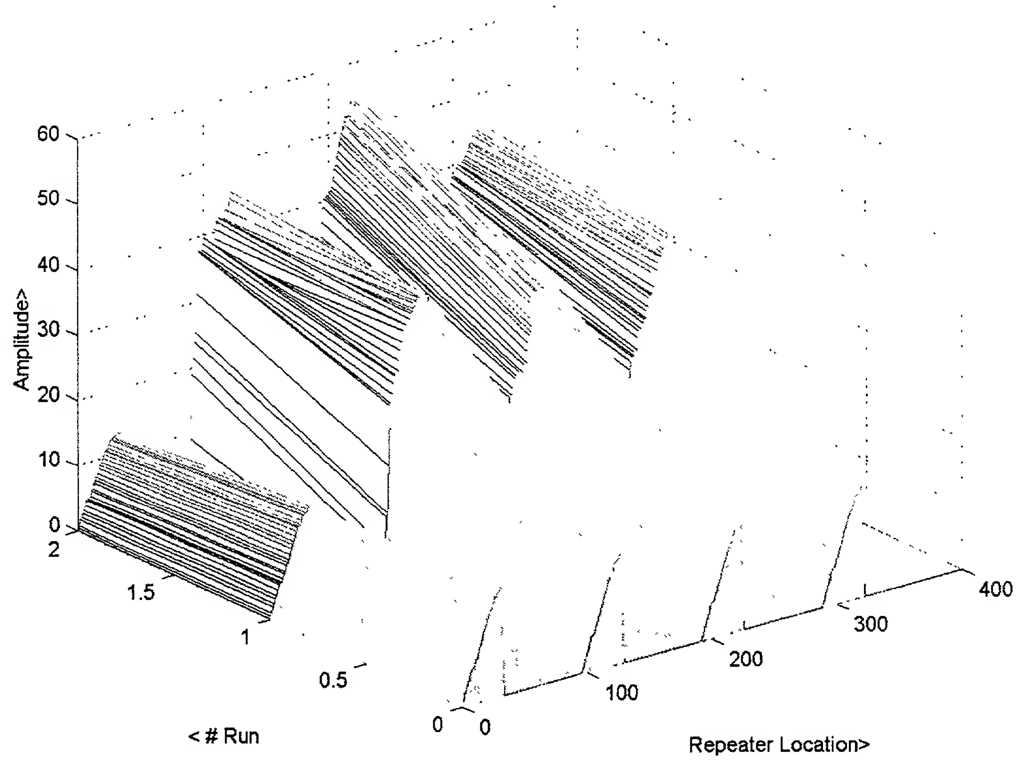
OCOPFNT2W Graphs



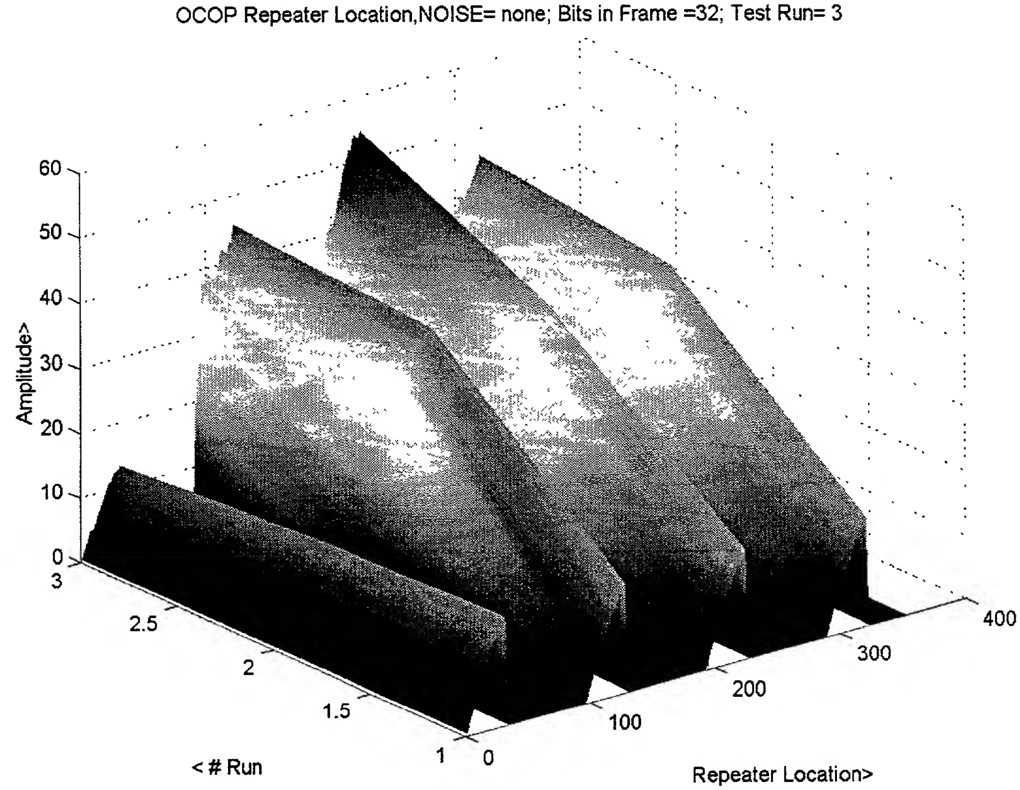

Channel Noise (0.05*(n-1)) + Power reduced (0.05*(n-3)) and n =2; Total Bits in Frame = 32
Amplitude [Peak (Bits)=43] >
<New Method-II
<ACF
Repeater Location (Bits or Km=Bits/5)>


Channel Noise (0.05*(n-1)) + Power reduced (0.05*(n-3)) and n =3; Total Bits in Frame = 32
Amplitude [Peak (Bits)=55] >
<New Method-II
<ACF
Repeater Location (Bits or Km=Bits/5)>

OCOP Repeater Location,NOISE= none; Bits in Frame =32; Test Run= 3



OCOP Repeater Location,NOISE= none; Bits in Frame =32; Test Run= 3



File: OCOPFNT2W **MATLAB CODES**

```
diary OCOPfnt2w.doc
% filename OCOPfnt2w
% compare ACF & New Technique-I for frame of 32,128 bits, with three runs for each
%fixed random bit patterns (PBRS)
% number of repeaters = 6
% channel noise in 2 and 3rd run,  power reduction in 3rd run

% requires double spacing between repeaters or less number of pulses in a Frame
% sensitive to channel noise, filter implementation artifacts
clg; clear;
ba=1;
out=[];
for wl=32:96:100,
        s=rand(wl,1);
% number of columns in the convolution matrix = wl+1
                % equal to number of bits per frame= LME-Tx PN1
truns=3;        % total runs for a given wordlength (wl);
for n=1:truns,  % simulate four different measurement tuns
                % nsx =no signal for lme receiver=the number of
                % zeroes are propotional to distance between
                % any two repeaters, set to vary with wl(easy)
        tic;
        %s=rand(wl,1);
                % generate different PRBS for each run
        ns1=zeros(wl,1);ns2=zeros(2*wl,1);ns3=zeros(3*wl,1);
        ns4=zeros(wl*4,1);ns5=zeros(5*wl,1);ns6=zeros(wl,1);
                if n >2,
                   pd=0.025*n; sn=s-s.*pd;
                  else sn=s; ;pd=0;
                end;
        z=[sn;ns2;s;ns2;s;ns2;s];%s;ns4;s;ns5;s;ns6]; % lme Tx data
                        % channel noise
                if n >1,
                  cn=0.05*n;z=z-cn.*rand(length(z),1);
                else noise=zeros(length(z)); cn=0;
                end;
        % The number of zeroes at the end of rinput (=z)= m= number of
        % information bit in rin as transmitted from LME and received
        % from individual repeaters at the LME receiver input

        repeater=convmtx(z,wl+1);   % generate padded columns
                                    % initialize for multiple runs
                        out1=0;             % initialize for single run
                                % for New Technique-I remove % below
```

```
                for j=1:wl+1, out1=out1+repeater(:,j); end;

            padl=zeros(wl,1);
            outpaded=[padl;out1];% Shifted, negative outnc vector
            outneg=outpaded(1:length(out1),:);
            %outf=out1-outneg.*(max(out1)/10);
            outf=out1-outneg.*(max(out1)-1);
                                % filter for DUMP after Peak
            for i=1:length(outf)
                if outf(i) <= 0
                  out1(i)=0;
                else out1(i)=outf(i);
                end
            end,

        out=[out,out1];                         % for 3-D plot

        peak=max(out1);                         % search for maxima in current out1
        m=find(out1 > peak-ba); [m m./5];   % get remaining peaks within, peak-ba
        km=m./5;                            % Kilometer = No. of Bits*1 micro-sec/bit*1/5
microsec per km
        Rfirst=km-km(1); IRS=0;                 % Repeaters location relative first repeater
        for q=1:length(km)-1,                   % compute Inter-Repeater span
            IRS1=km(q+1)-km(q); IRS=[IRS;IRS1];end

        lmeout=[km Rfirst IRS m log2(m)];

        fprintf(1,'Time Stamp\n');
        fprintf(1,'Year= %g, Month= %g, Day= %g, Time (EST) = %g:%g:%g ; \n Computation
Time (sec)=%g ;\n',clock,toc)
        fprintf('***** Repeaters have been found with an accuracy of %g  Bit(s) or %g Km
*****\n',ba, ba/5)
        fprintf(1,'Word length (Bits)= %5.1f;  Run Number = %6.1f;  Peak Value (Sum of Bits)
=%6.2f \n',wl,n,peak)
        fprintf('\n_____________\n')
        fprintf(1,'%12s;%17s;%24s\n','Distance','Relative to 1st','Inter-Repeater Span')
        fprintf(1,'%9s;%12s;%19s;%18s;%12s\n','Km','Km','Km','Bits','log2(Bits)')
        fprintf('-----------------------------------------------------------------------\n')
        fprintf(1,'%9.2f;%12.2f;%19.2f;%18.1f;%8.2f\n',lmeout')


        plot(out1,'g:'), axis([0 length(out1) -1 max(out1)]), axis(axis); hold on,
        title(['Channel Noise (0.05*(n-1)) + Power reduced (0.05*(n-3)) and n =',int2str(n),';
Total Bits in Frame = ',int2str(wl)]),
        xlabel('Repeater Location (Bits or Km=Bits/5)>'),
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```
        ylabel(['Amplitude [Peak (Bits)=',int2str(max(out1)),'] >']);
        plot(xcorr(sn),'b'); bar(z,'r'),
        %legend('New Method-I','ACF','LME Rx Data');
        gtext('<ACF');gtext('<New Method-II'); hold off
        %print
        figure
  end

 outf=out;

out=[];
end
diary off

%break % remove break to see 3D plots
        % 3D- plot for truns more than ONE else error, let truns=4, will
        %hidden % to be used for transparent mesh
        meshz(outf);zlabel('Amplitude>'), xlabel('Repeater Location>'),ylabel('< # Run')
        title(['OCOP Repeater Location,NOISE= none; Bits in Frame =',int2str(wl),'; Test Run=
',int2str(n)']),
        figure,
        surf(outf),shading interp, %colormap(gray)
        colormap(jet),
        zlabel('Amplitude>'), xlabel('Repeater Location>'),ylabel('< # Run')
        title(['OCOP Repeater Location,NOISE= none; Bits in Frame =',int2str(wl),'; Test Run=
',int2str(n)']),
```